



**SOUTH CAROLINA
STATE DEPARTMENT
OF EDUCATION**

South Carolina Department of Education Support for Implementing the Common Core State Standards for Mathematics

Algebra 1: Sequence Unit

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Rita Bixler, Greenville County Schools





**Common Core
Is
Coming!!**



**Common Core
Is
Coming!!**





Ode to Common Core

Listen, my friends
and you shall hear
Of the Common Core Standards
that are drawing near.
The rigor is up.
The assessment is new.
What, oh what, is a teacher to do?



To meet this challenge,
We'll make a plan.

And working together,
I know we can

Keep moving forward
and never stop

To be sure that South Carolina's students
come out on top.



Common Core State Standards for Mathematics

Two Types

**Standard for Mathematical Content
and
Standards for Mathematical Practice**



Standards for Mathematical Content Conceptual Categories - HS

- **Number and Quantity**
- **Algebra**
- **Functions**
- **Geometry**
- **Statistics and Probability**
- **Modeling**

Structure of HS Courses

From Appendix A of CCSSM

Course	Comprised of Standards from various Conceptual Categories	
Algebra 1	Number and Quantity Algebra Functions Statistics and Probability	Modeling
Geometry	Geometry Statistics and Probability	Modeling
Algebra 2	Number and Quantity Algebra Functions Statistics and Probability	Modeling



New Algebra 1 Content Standards in this Unit

- F.IF.3** Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.
- F.BF.1a** Determine an explicit expression, a recursive process, or steps for calculation from a context. (*linear and exponential in this unit*)
- F.BF.2** Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.
- F.LE.2** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).



Related 2007 SC Academic Mathematics Standards

EA-5.9 Analyze given information to write a linear function that models a given problem situation.

IA-6.1 Categorize a sequence as arithmetic, geometric, or neither.

IA-6.3 Carry out a procedure to write a formula for the n th term of an arithmetic or geometric sequence when given at least four consecutive terms of the sequence.

IA-6.4 Carry out a procedure to write a formula for the n th term of an arithmetic or geometric sequence when given at least four terms of the sequence.



Related 2007 SC Academic Mathematics Standards

- IA-6.7 Carry out a procedure to determine consecutive terms of a sequence that is defined recursively.**
- IA-6.8 Carry out a procedure to define a sequence recursively when given four or more consecutive terms of the sequence.**
- IA-6.9 Translate between the explicit form and the recursive form of sequences.**
- PC-4.6 Analyze given information to write an exponential function that models a given problem situation.**

Content Changes


Topic	SC 2007 Academic Math Standards	Common Core State Standards
Introduction to arithmetic and geometric sequences	Grades 2, 3, 4, 5, 6, 7, (create and analyze a variety of patterns) Algebra 2	Grades 4 and 5 (Patterns) Algebra 1
Write arithmetic and geometric sequences both recursively and explicitly and translate between the two forms.	Algebra 2	Algebra 1
Introduction to exponential functions.	Precalculus	Algebra 1
Connection between arithmetic and geometric sequences and linear and exponential functions	Not present	Algebra 1



The Standards for Mathematical Practice

*The Standards for Mathematical Practice describe varieties of **expertise** that mathematics educators at all levels should seek to develop in their students. These practices rest on important "**processes and proficiencies**" with longstanding importance in mathematics education.*

-Common Core State Standards for Mathematics,
page 6



Standards for Mathematical Practice

- **Similar to current South Carolina Math Process Standards**
- **The same for all grade levels K-12**
- **Describe habits of mind of a mathematically expert student**



Standards for Mathematical Practice

- 1. Make sense of problems and persevere in solving them.**
- 2. Reason abstractly and quantitatively.**
- 3. Construct viable arguments and critique the reasoning of others.**
- 4. Model with mathematics.**
- 5. Use appropriate tools strategically.**
- 6. Attend to precision.**
- 7. Look for and make use of structure.**
- 8. Look for and express regularity in repeated reasoning**

Deeper Look at SMP

For each one:

- Read each SMP.
- With your partner put into your own words what this standard means for student attitudes, behaviors, or types of expertise.
- Share your thoughts with the group.





SBAC Test Structure

Concepts and Procedures (Content Standards)	40%
Problem Solving (Std for Math Practice)	60%
Communicating Reasoning (Std for Math Practice)	
Modeling and Data Analysis (Std for Math Practice)	



Thinking Must Change



- Assessment will test what is important, not just what is easy to test.
- Students must be able to solve messy, never-seen-before problems.
- Students must be able to clearly communicate their reasoning.
- Students must be able to model with mathematics.



Algebra 1 Sequence Unit

- The unit is designed for students to work in pairs and groups of 4
- The activities are designed so that students learn the math by working through the activities.
- Student's new knowledge is reinforced through reflecting on their work and discussing/summarizing with their classmates.



Algebra 1 Sequence Unit

- Student notes and vocabulary are embedded in the activities.
- The teacher's role is that of facilitator-to "set up" the activity for students and then facilitate student reflection, discussion, and summarizing of the content.

Let's Get Started!

- Experience the unit as if you are an Algebra 1 student.
- But I will also ask you to alternate between wearing your "student hat" and your "teacher hat."





Activity 1- Sorting Sequences

Locate the set of sequences paper clipped together on your table. With your partner do the following:

- List the next five terms of each sequence.
- Describe the pattern in the space provided.
- Sort the sequences into separate groups based on common characteristics you identify.



Time to Share

- How many groups did you make?
- Describe your categories.
- Did you use any of the SMP's as you sorted?



Sequences are named by the patterns that generate them.

Read the descriptions on page 3 of packet.

- Arithmetic sequence
- Geometric sequence

Add notes to your Graphic Organizer



Activity 2- Sorting Re-visited

With your partner:

- Sort sequences A through N a second time.
- Determine which are arithmetic, which are geometric, and which are neither.
- For each sequence, explain your choice.



Time to Share

- Which sequences are Arithmetic?
- Which sequences are Geometric?
- Which are neither?
- Analyze the characteristics of each type.
- Add notes to your graphic organizer

What SMPs did you use?

Activity 3: Defining an Arithmetic Sequence

- Independently create a sequence to match each description I give you.
- Compare your answers with your partner. Then compare your answers with others at your table.





Activity 3: Defining an Arithmetic Sequence

- Discuss with the group what information you think is needed to make sure everyone writes the same arithmetic sequence. Make a conjecture based on your observations.
- Share your conjecture with the class.
- What SMP's did you use?



Activity 4: Recursively Defined Function

Teacher


- Set up this activity (page 4) by discussing the term/concept of recursive formula.
- Discuss the functional notation used.
- Assign students to complete #1-8.
- Facilitate discussion.
- Have students add to graphic organizer.

What SMP's did you use?

Activity 4 continued

- Complete #9-15. Be prepared to discuss.
- Assign # 16-17 to check for understanding.
- Add notes to graphic organizer.





Activity 5: Calculating the 100th term of an Arithmetic Sequence

- With your partner, try to find a method of determining the 100th term without using a calculator or calculating the 99 terms that precede it.
- Then share your methods with others at your table.

Activity 5 continued

- Discuss the different approaches used with the whole group.
- What SMP's did you use in solving this problem?
- Analyze student work done by Michael's group and Susan's group on page 7.





Activity 6: Determining Explicit Rule for n^{th} term of Arithmetic Sequence

- Discuss the meaning of n^{th} term and explicit rule.
- Building on Michael's and Susan's methods, complete #1-3 (Michael) and #1-4 (Susan).
- Discuss #5: Do the two methods yield the same formula?
- Check for understanding: #6-7



Activity 6:Continued

- Complete #8-11.
- Discuss connection between arithmetic sequences and linear functions.
- Add notes to graphic organizer. Whole class review of GO to allow teacher to address misconceptions.



Stacking Cups Activity

Explore an arithmetic sequence(function) in a real world context using tables, graphs, symbols.

As you work, consider the SMPs that are being used.



Activity 7: Geometric Sequences through Recursive Thinking

- Revisit the definition of Geometric Sequence that we encountered at the beginning of the unit.
- Work through #1-10 together with students.
- Add notes to GO for Geometric Sequences.
- Do #11-18 independently. Compare your answers with your partner.
- What SMPs did you use?



Activity 8: Determining a Rule for the n^{th} term

- Complete #1-5
- Discussion: How does the explicit formula for a geometric sequence relate to the general form of an exponential function?



Activity 8: Determining a Rule for the n^{th} term

- Complete #6-9 to check for understanding.
- Add notes the graphic organizer.
- Facilitate class discussion of notes on GO to check for any omission or correct misconceptions.



Comparison

How are arithmetic sequences and geometric sequence alike?

How are they different?

Summarize using the GO.

Bright Lights Activity

Explore a geometric sequence(function) in a real world context using tables, graphs, symbols.

As you work, consider the SMPs that are being used.

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Optional Review

- Revisit the sequences in the sorting activity.
- Write both the recursive and explicit formulas for the sequences that were identified as arithmetic or geometric.





SBAC Sample TE Item F.BF.1 SMP 1,2,7

- A new social networking website was made available. The website had 10 members its first week. Beginning the second week, the creators of the website have a goal to triple the number of members every week.
- For *Part A* and *Part B* below, select the appropriate expression for each blank region. To place an expression in a region, click on the expression, move the pointer over the region, and click again to place the expression in the region. Only one expression can be placed in each region. To return all expressions to their original positions, click the Reset button.



0	1	3	7	10
$3n+7$	$3n+10$	$30(n-1)$	$10(3^{n-1})$	$3(10^{n-1})$
$f(n-1)+2$	$f(n-1)+30$	$3f(n-1)$	$3f(n-1)+10$	$f(3n-1)$

Part A

Determine an explicit formula for $f(n)$, the number of members the creators have a goal of getting n weeks after the website is made available.

$$f(n) = \boxed{}$$

Part B

Determine a recursive formula for $f(n)$.

$$f(n) = \boxed{} \quad \text{for } n > \boxed{}$$

$$f(1) = \boxed{}$$

SBAC Sample TE Item F.BF.2

SMP 1,2,4,7

The first four terms of a sequence are shown below.

8, 12, 18, 27, ...

Write a recursive function for this sequence.



What are Students Doing?

- Actively engaging in the learning process (SMP 1)
- Using existing mathematical knowledge to make sense of the task (SMP 1-3)
- Making connections among mathematical concepts (SMP 2, 7, 8)



What are Students Doing?

- Reasoning and making conjecture about the problem (SMP 1, 2, 3)
- Communicating their mathematical thinking orally and in writing (SMP 3 and 6)
- Listening and reacting to others' thinking and solutions to problems (SMP 3)



What are Students Doing?

- Using a variety of representations, such as pictures, tables, graphs, and words, for their mathematical thinking. (SMP 4)
- Using mathematical and technological tools such as physical materials, calculators, computers, textbooks, and other instructional materials. (SMP 5)
- Building new mathematical knowledge through problem solving (SMP 1-8)



What is the Teacher Doing?

- Choosing “good” problems – ones that invite exploration of an important mathematical concept and allow students the chance to solidify and extend their knowledge (SMP 1, 4, 7, 8)
- Assessing students’ understanding by listening to discussions and asking students to justify their responses (SMP 3 and 6)



What is the Teacher Doing?

- Using questioning techniques to facilitate learning (SMP 3 and 6)
- Encouraging students to explore multiple solutions (SMP 7 and 8)
- Challenging students to think more deeply about the problems they are solving and to make connections with other ideas within mathematics (SMP 1, 2, 7, 8)



What is the Teacher Doing?

- Creating a variety of opportunities, such as group work and class discussions, for student to communicate mathematically (SMP 3 and 6)
- Modeling appropriate mathematical language and a disposition for solving challenging mathematical problems (SMP 1, 3, 4, 6)

